		Monitoring Activity																								Linked Activities							
	Key Questions	Bird surveys (Salton Sea shoreline)	Bird surveys (Salton Sea open water)	Bird surveys (agricultural lands)	Bird surveys (adjacent refuges)	Bird surveys (Created Saline Habitats)	Breeding bird surveys (Salton Sea shoreline and river mouths)	Roost site counts (ibis, egrets, ag land species)	Landbird surveys (halophytic scrub)	Bird condition measurements (individuals)	Dead and sick bird counts (Salton Sea)	Snag and Island inventory (Salton Sea nearshore)	Fish surveys (Salton Sea)	Fish surveys (shoreline pools)	Fish surveys (pupfish drains)	Fish surveys (river mouths)	Fish surveys (created habitats)	Fish kill counts	Water column invertebrate/plankton surveys (Salton Sea and river mouths)	Benthic invertebrate survey (Salton Sea and river mouths)	Epibsodic invertebrate/plankton survey)	Pileworm surveys (Salton Sea)	Water column invertebrate/plankton surveys (Created habitats)	Benthic invertebrate survey (Created habitats)	Salinity measurements (Salton Sea, river mouths)	Air and water temperature measurements	Salton Sea bathymetry	Salton Sea sediment characterization	Project area aerial photography	Flow measurements (river mouths)			
	BIRDS																																
3	What is the condition and trend of bird use at the Salton Sea?																																
3a	- What bird species use the Salton Sea area?	X	X	X	X	X	X	X	X																								
3b	- When and how do they use the Salton Sea area?	X	X	X	X	X	X	X	X																								
3c	- What is the spatial and seasonal distribution of their use?	X	X	X	X	X	X	X	X																			X					
3d	- What are the trends in bird abundance and diversity in the Salton Sea area over time?	X	X	X	X	X	X	X	X																								
4	Which attributes and conditions will be most important in planning and managing potential future habitats for birds?																																
4a	- How does water depth influence use? (also substrate, salinity)	X	X			X	X																		X		X	X	X				
4b	- How do the presence and locations of snags and islands influence use?	X				X	X	X				X																					
4c	- How is bird use at the Salton Sea influenced by proximity of adjacent agricultural lands?	X		X			X	X																				X					
4d	- How is bird use at the Salton Sea influenced by the adjacent refuges?	X	X		X		X	X																				X					
4e	- How does the availability of food influence bird use?	X	X				X	X					X						X	X									X				
4g	- What is the bird use relative to edge?	X					X	X	X																					X			
4h	- What is bird use relative to freshwater inputs and how do freshwater inputs to the Sea influence bird use?	X			X		X	X																	X				X				
5	What factors contribute to the productivity of breeders at the Salton Sea?						X					X	X		X	X			X	X	X				X					X			
6	What are the conditions that result in disease outbreaks at the Salton Sea?										X		X					X							X	X		X					
6b	- What are the vectors likely to transmit disease and the conditions that support transmission?										X		X					X	X	X													
9	Are the conditions at the Salton Sea contributing to bird population integrity/viability/health?									X																							
	FISH (excluding desert pupfish)																																
11	What is the condition and trend of fish use at the Salton Sea?																																
11a	- What fish species currently use the Salton Sea?												X	X	X	X																	
11b	- What is their abundance over time?												X	X	X	X																	
11c	- What are the important environmental attributes associated with their use?												X	X	X	X									X	X	X	X		X			
12	Which attributes and conditions will be most important in planning and managing potential fish habitat at the Salton Sea?																																
12c	- What is the fish abundance at the Whitewater, New, and Alamo river mouths and how is abundance related to flow?															X									X					X			
12e	- What are the linkages between avian botulism and fish die-offs?										X							X															
12f	- What fish species currently inhabit the Salton Sea and its tributaries, including agricultural drains												X	X	X	X	X																
12h	- What is the status of extant fish species, and in what habitats are they found?												X	X	X	X	X																
12i	- What are population trends (patterns) over multiple generations, and what environmental variables influence their abundance/distribution?												X	X	X	X	X								X	X	X	X		X			

	DESERT PUPFISH																													
15	What is the condition and trend of desert pupfish use at the Salton Sea and its tributaries?																													
15a	- What is their abundance over time?													X	X		X													
15b	- What are the important environmental attributes associated with their use?													X	X		X							X	X	X	X		X	
16	Which attributes and conditions will be most important in planning and managing potential desert pupfish habitat at the Salton Sea?																													
16h	- How are current pupfish populations influenced by disease and parasites?													X	X		X							X	X				X	
	INVERTEBRATES																													
	What is the condition and trend of benthic/aquatic invertebrate populations at the Salton Sea?																													
	- What kinds of invertebrates are found in the Salton Sea?																	X	X	X	X									
	- When and how do they use the Salton Sea?																	X	X	X	X									
	- What is their abundance over time?																	X	X	X	X	X	X							
	Which environmental attributes and conditions will most influence the planning and management of potential future habitats to provide invertebrate food resources for fish and birds?																	X	X	X	X	X	X	X	X	X	X		X	
	- What is the status of pileworms?																	X	X	X	X									
	- When would brine shrimp/flies become dominant?																	X				X	X	X					X	
	PLANKTON																													
21	What is the condition and trend of plankton populations at the Salton Sea?																	X		X										
21a	- What plankton species currently use the Salton Sea?																	X		X										
21b	- What is the species composition and abundance over time?																	X		X										
22	Which conditions will be most important in planning and managing potential future habitats to support plankton populations as key components of the ecosystem?																	X		X				X	X	X			X	
22c	- How does species diversity within the Salton Sea compare to existing created habitats?																	X		X		X								
22d	- How do changes in diversity correspond to changes in water quality and community structure?																	X		X		X		X	X				X	
		Geography, Geology, and Engineeering Group																												
		Hydrology and Water Quality Group																												

		Monitoring Activity											Linked Activities									
	Key Questions	Bird surveys (Salton Sea shoreline)	Bird surveys (Salton Sea open water)	Bird surveys (agricultural lands)	Bird surveys (adjacent refuges)	Bird surveys (Created Habitats)	Breeding bird surveys (Salton Sea shoreline and river mouths)	Roost site counts (ibis, egrets, ag land species)	Landbird surveys (halophytic scrub)	Bird condition measurements (individuals)	Dead and sick bird counts (Salton Sea)	Snag and Island inventory (Salton Sea nearshore)	Salinity measurements (Salton Sea, river mouths)	Air and water temperature measurements	Salton Sea bathymetry	Salton Sea sediment characterization	Project area aerial photography	Flow measurements (river mouths)				
	BIRDS																					
3	What is the condition and trend of bird use at the Salton Sea?																					
3a	- What bird species use the Salton Sea area?	X	X	X	X	X	X	X	X													
3b	- When and how do they use the Salton Sea area?	X	X	X	X	X	X	X	X													
3c	- What is the spatial and seasonal distribution of their use?	X	X	X	X	X	X	X	X								X					
3d	- What are the trends in bird abundance and diversity in the Salton Sea area over time?	X	X	X	X	X	X	X	X													
4	Which attributes and conditions will be most important in planning and managing potential future habitats for birds?																					
4a	- How does water depth influence use? (also substrate, salinity)	X	X			X	X						X		X	X	X					
4b	- How do the presence and locations of snags and islands influence use?	X				X	X	X				X										
4c	- How is bird use at the Salton Sea influenced by proximity of adjacent agricultural lands?	X		X			X	X									X					
4d	- How is bird use at the Salton Sea influenced by the adjacent refuges?	X	X		X		X	X									X					
4e	- How does the availability of food influence bird use?	X	X				X	X								X						
4g	- What is the bird use relative to edge?	X					X	X	X								X					
4h	- What is bird use relative to freshwater inputs and how do freshwater inputs to the Sea influence bird use?	X			X		X	X					X				X					
5	What factors contribute to the productivity of breeders at the Salton Sea?						X					X	X					X				
6	What are the conditions that result in disease outbreaks at the Salton Sea?																					
6b	- What are the vectors likely to transmit disease and the conditions that support transmission?										X		X	X								
9	Are the conditions at the Salton Sea contributing to bird population integrity/viability/health?									X			X	X								

		Monitoring Activity						Linked Activities									
	Key Questions	Fish surveys (Salton Sea)	Fish surveys (shoreline pools)	Fish surveys (pupfish drains)	Fish surveys (river mouths)	Fish surveys (created habitats)	Fish kill counts	Salinity measurements (Salton Sea, river mouths)	Air and water temperature measurements	Salton Sea bathymetry	Salton Sea sediment characterization	Project area aerial photography	Flow measurements (river mouths)				
	FISH (excluding desert pupfish)																
11	What is the condition and trend of fish use at the Salton Sea?																
11a	- What fish species currently use the Salton Sea?	X	X	X	X												
11b	- What is their abundance over time?	X	X	X	X												
11c	- What are the important environmental attributes associated with their use?	X	X	X	X			X	X	X	X		X				
12	Which attributes and conditions will be most important in planning and managing potential fish habitat at the Salton Sea?																
12c	- What is the fish abundance at the Whitewater, New, and Alamo river mouths and how is abundance related to flow?				X			X					X				
12e	- What are the linkages between avian botulism and fish die-offs?						X										
12f	· What fish species currently inhabit the Salton Sea and its tributaries, including agricultural drains	X	X	X	X	X											
12h	- What is the status of extant fish species, and in what habitats are they found?	X	X	X	X	X											
12i	- What are population trends (patterns) over multiple generations, and what environmental variables influence their abundance/distribution?	X	X	X	X	X		X	X	X	X		X				
	DESERT PUPFISH																
15	What is the condition and trend of desert pupfish use at the Salton Sea and its tributaries?																
15a	- What is their abundance over time?		X	X		X											
15b	- What are the important environmental attributes associated with their use?		X	X		X		X	X	X	X		X				
16	Which attributes and conditions will be most important in planning and managing potential desert pupfish habitat at the Salton Sea?																
16h	- How are current pupfish populations influenced by disease and parasites?		X	X		X		X	X				X				

Key Questions

Draft Summary of Biological Monitoring Activities

	Monitoring Detail							
Monitoring Activity	Location	Time Period	Frequency	Protocol	Data Collection	Expected Analysis	Possible Additional Data Use	Data Collection Status
Bird surveys (Salton Sea shoreline)	Perimeter of Salton Sea	Late winter (15 Jan - 15 Feb); Spring migration (mid April); Breeding season, (mid - late May); Early fall (mid Aug); Early winter (mid Nov).	Seasonally, one survey per period	Boat survey: complete counts of all waterbird species observed, broken down by shoreline segment. Habitat characterization	Bird species, number, location, and general habitat Shoreline type; shoreline substrate, habitat features	Trends in species composition, and habitat use	Assessment of species/habitat associations Movement patterns and habitat use Inter- and intra-specific interactions	
Bird surveys (Salton Sea open water)	Open water of Salton Sea	December through January	Annually, one survey in each basin (north-south)	Boat transects across north and south basins consisting of four parallel 10 km transects; offset by 2 km Complete counts of all waterbird species within 300m on either side of transect	Bird species composition, number.	Trends in species composition and abundance	Movement patterns and habitat use	
Bird surveys (agricultural lands)	Imperial and Coachella valley agricultural areas	Seasonally			All covered species, number of individuals, habitat characteristics (e.g., crop type, status)	Trends in species composition, abundance, and habitat use	Assessment of species/habitat associations Movement patterns and habitat use Behavior Inter- and intra-specific interactions	IID currently conducting transect surveys in agricultural areas in Imperial Valley
Bird surveys (adjacent refuges)	Ponds on adjacent State and Federal refuges and wildlife areas	Late winter (15 Jan - 15 Feb); Spring migration (mid April); Breeding season, (mid - late May); Early fall (mid Aug); Early winter (mid Nov).	Seasonally, one survey per period	Land based survey: complete counts of all waterbird species observed, habitat characterization; focal T&E species surveys (e.g., broadcast call and response surveys)	Bird species, number, and general habitat characteristics	Trends in species composition, abundance, and habitat use	Assessment of species/habitat associations Movement patterns and habitat use Inter- and intra-specific interactions	CDFG and USFWS currently conduct Yuma clapper rail and California black rail surveys on refuges.

Bird surveys (Created Saline Habitats)	USGS and TM Ponds	Late winter (15 Jan - 15 Feb); Spring migration (mid April); Breeding season, (mid - late May); Early fall (mid Aug); Early winter (mid Nov).	Seasonally, one survey per period	Land based survey: complete counts of all waterbird species observed. Habitat characterization	Bird species composition, number, location, and general habitat Shoreline type; shoreline substrate, habitat features	Trends in species composition, abundance, and habitat use	Assessment of species/habitat associations Movement patterns and habitat use Inter- and intra-specific interactions	
Breeding bird surveys (Salton Sea shoreline and river mouths)	Perimeter of Salton Sea	February through May		Aerial reconnaissance Complete counts (boat and on foot) Repeat visits to occupied sites	Enumeration and mapping of all colonies of herons, egrets, ibis, and cormorants around the Salton Sea	Estimate the number of breeding pairs and phenology of nesting	Trends in breeding success	
Landbird surveys (halophytic scrub)	Salton Sea shoreline and adjacent alkali flats with halophytic scrub	Early-fall (Aug/Sep), Late-winter (Dec/Jan) and breeding season (Apr/May)	Seasonally, with 2 replicates per site	Multiple study regions along the shoreline; multiple area search sites in each region	Species composition, counts of individuals, and habitat associations for all birds in search areas	Trends in species composition, abundance and habitat use	Assessment of species/habitat associations Movement patterns and habitat use	IID currently conducting bird surveys in tamarisk scrub along the New and Alamo rivers
Bird condition measurements (individuals)								
Dead and sick bird counts (Salton Sea)	Salton Sea and refuges	Year Round	Episodic		Species and numbers of birds affected. Retain samples for analysis	Trends in magnitude and location of disease events. For analyzed specimens, causal agents.		USFWS and CDFG currently track bird mortality events
Snag and Island inventory (Salton Sea nearshore)	Salton Sea shoreline	High and low Sea elevation during year	Seasonally, one survey per elevation period		Snag number and location; island area and location	Trend in number, area, and availability of snags and islands.	Snag type and density needed to support bird use; island characteristics needed to support bird use. Linked with bird surveys, species use and relative importance.	
Fish surveys (Salton Sea)	Shallow areas of the Salton Sea	Spring (Apr-May), Summer (Jul/Aug), Fall (Oct/Nov) and Winter (Jan/Feb)	Seasonally, at nearshore sites and pelagic sites	Muliti-panel gillnets at surface of nearshore sites and surface and bottom of pelagic sites	Species composition, counts of individuals, size, and sex/breeding condition of adults	Trends in species composition, abundance (CPUE)	Reproductive success	CDFG currently conducts surveys
Fish surveys (shoreline pools)								
Fish surveys (pupfish drains)	26 Pupfish drains and 3 shoreline pools	January, April, June, October	Seasonally	Minnow traps	Species composition, counts of individuals	Trends in species composition, abundance	Assessment of species/habitat associations Movement patterns and habitat use Inter- and intra-specific interactions	USGS and IID conducting surveys

Fish surveys (river mouths)	Delta and shallow areas of the Salton Sea at the river mouths	January, April, June, October	Seasonally, at estuarine sites		Species composition, counts of individuals, size, and sex/breeding condition of adults	Trends in species composition, abundance (CPUE)	Reproductive success. In combination with flow measurements, the relation of fish use at the river mouths to flow.	
Fish surveys (created saline habitats)								
Fish kill counts		Episodic when fish kills occur	Episodic when fish kills occur		Numbers and species of dead fish, and location; specimens collected for analysis.	Estimate of species composition and numbers affected. Analysis of collected specimens to determine causal agent.	In combination with water quality data and satellite photography, analysis of the magnitude of H_2S effects.	
Water column invertebrate/plankton surveys (Salton Sea and river mouths)				Tow nets, sweep nets	Species composition, counts of individuals	Trends in species composition, abundance	Relationships to salinity, temperature, and water quality	
Benthic invertebrate survey (Salton Sea and river mouths)			Seasonally, multiple transects, multiple sites per transect	Grab samples of soft substrates; quadrat sampling of hard substrates; core sampling of barnacle substrates	Species composition, counts of individuals	Trends in species composition, abundance	Relationships to salinity, temperature, and water quality	
Episodic invertebrate/plankton survey)				Tow nets, sweep nets	Species composition, counts of individuals	Trends in species composition, abundance	Relationships to salinity, temperature, and water quality	
Pileworm surveys (Salton Sea)				Dredge, tow nets	Species composition, counts of individuals	Trends in species composition, abundance	Relationships to salinity, temperature, and water quality	
Water column invertebrate/plankton surveys (Created saline habitats)				Tow nets, sweep nets	Species composition, counts of individuals	Trends in species composition, abundance	Relationships to salinity, temperature, and water quality	
Benthic invertebrate survey (Created saline habitats)				Grab samples	Species composition, counts of individuals	Trends in species composition, abundance	Relationships to salinity, temperature, and water quality	
Linked Activities								
Salinity measurements (Salton Sea, river mouths)								
Air and water temperature measurements								
Salton Sea bathymetry								
Salton Sea sediment characterization								
Project area aerial photography								
Flow measurements (river mouths)								